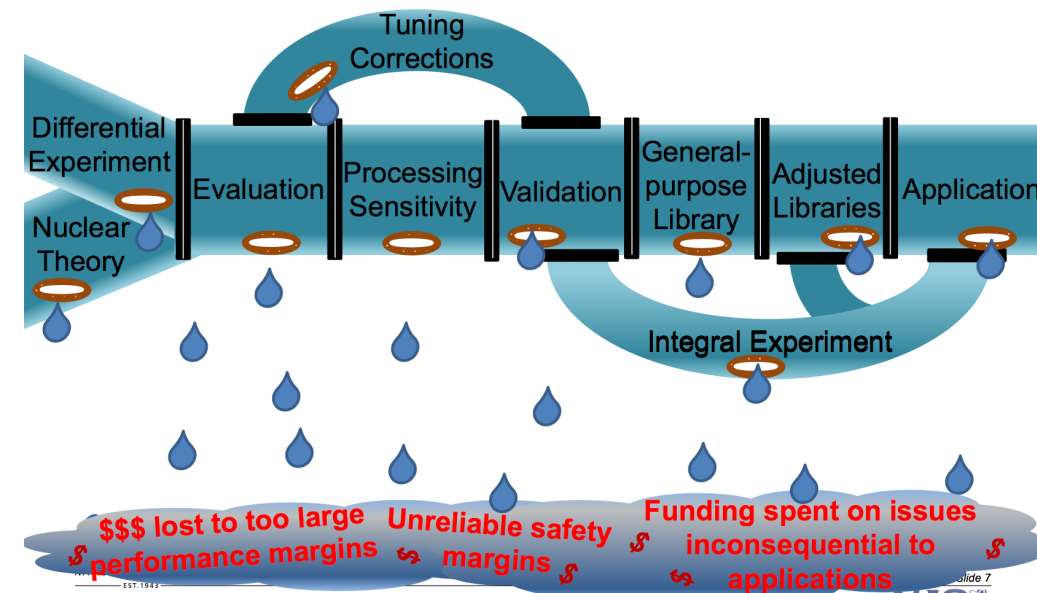# Session Summary – WANDA2020 Covariance/ Sensitivity/ Validation and its Impact on Applications

Prepared for WANDA 2021, 1/25/21

Nuclear data uncertainties limit precision and accuracy of predictive application simulations – or finding the leaks in the covariance pipeline.
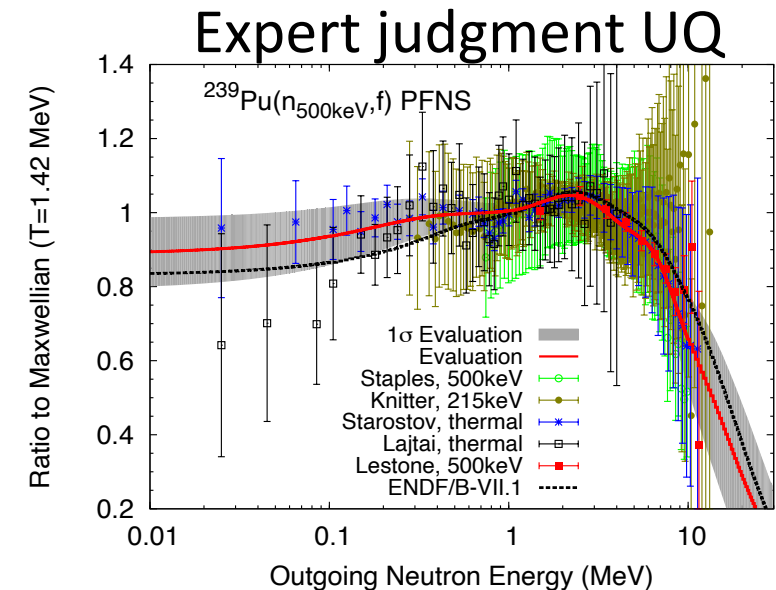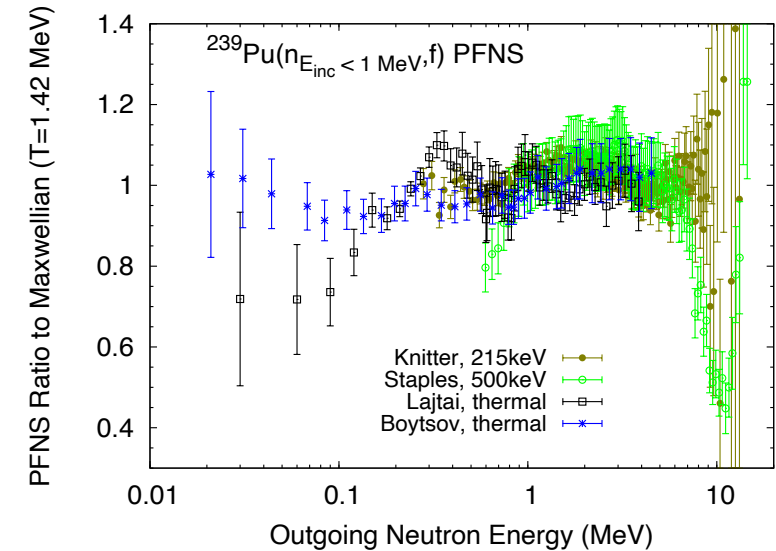
LA-UR-21-20369

Slides written by F. Bostelmann, R. Casperson, D. Neudecker, F. Tovesson

Differential experimental data covariance needs:

❑ Vetted and easier readable EXFOR for evaluations and testing if evaluated uncertainties are realistic → uncertainties supplemented by templates of expected measurement uncertainties (WPEC SG50)

❑ During designing experiments, their potential impact on applications should be tested→ involves evaluators and uncertainty propagation to applications.

❑ Uncertainties ought to be reported for each funded measurement → encouraged through funding, journals, templates and EXFOR
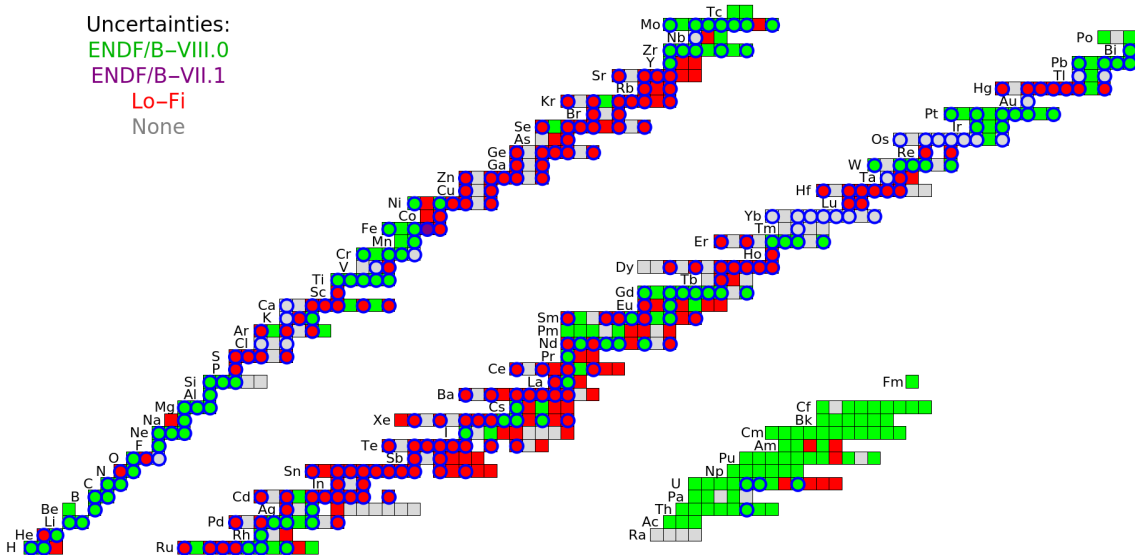
Taking data blindly from EXFOR

^{239}Pu($n_{E_{inc} < 1\,MeV}$,f) PFNS

Knitter, 215keV
Staples, 500keV
Lajtai, thermal
Boytsov, thermal

PFNS Ratio to Maxwellian (T=1.42 MeV)

Outgoing Neutron Energy (MeV)

Expert judgment UQ

^{239}Pu(n_{500keV},f) PFNS

1σ Evaluation
Evaluation
Staples, 500keV
Knitter, 215keV
Starostov, thermal
Lajtai, thermal
Lestone, 500keV
ENDF/B-VII.1

Ratio to Maxwellian (T=1.42 MeV)

Outgoing Neutron Energy (MeV)

D. Neudecker

Evaluated covariance needs:

Chart of available covariances

❑ Establish covariance high-priority list including feedback from applications what is important.

❑ Complete covariance libraries (including FP`TSL, angular distributions) → community prefers low-fidelity covariances instead of 0, mid-fidelity would be great.

❑ General-purpose library for adjustment and tools for adjusting

Uncertainties:
ENDF/B−VIII.0
ENDF/B−VII.1
Lo−Fi
None

T. Bailey

| Nucleus	Summation Yield	Sum. ΔYield	Sum. Δyield No Corrs.
[235]U	6.37	2.58%	1.76%
[238]U	9.69	2.51%	2.04%
[239]Pu	4.39	3.19%	2.08%
[241]Pu	6.25	3.27%	2.36%

A. Sonzogni

Documentation/ quality assurance needs:

☐ Timeline of library release must allow for verification and validation for covariances

☐ Document:
   - quality of covariances across libraries
   - recommendations how to merge libraries for complete libraries
   - nuclear data tweaks and validation experiments used during library validation.

☐ Assess quality of only theory-supported nuclear data

ENDF/B VIII.0
O16 XS, mubar and +/- 1 stdev

K. Parsons

H-1 elastic uncertainty
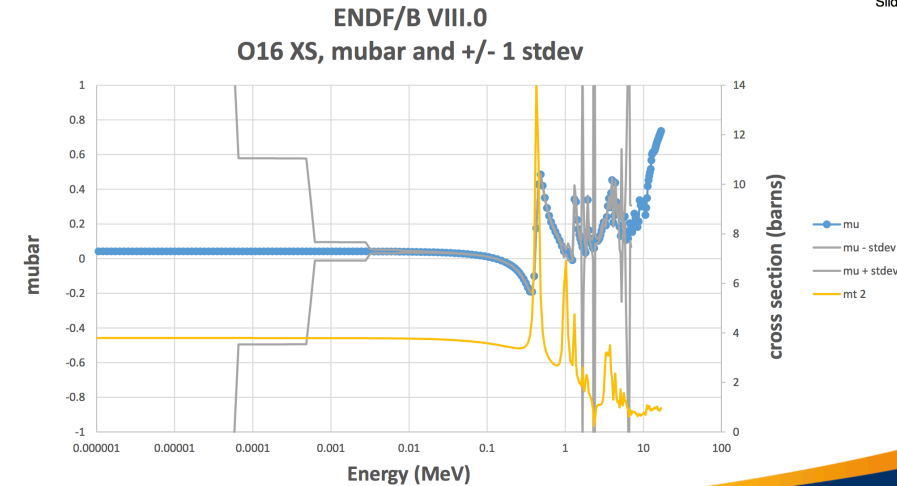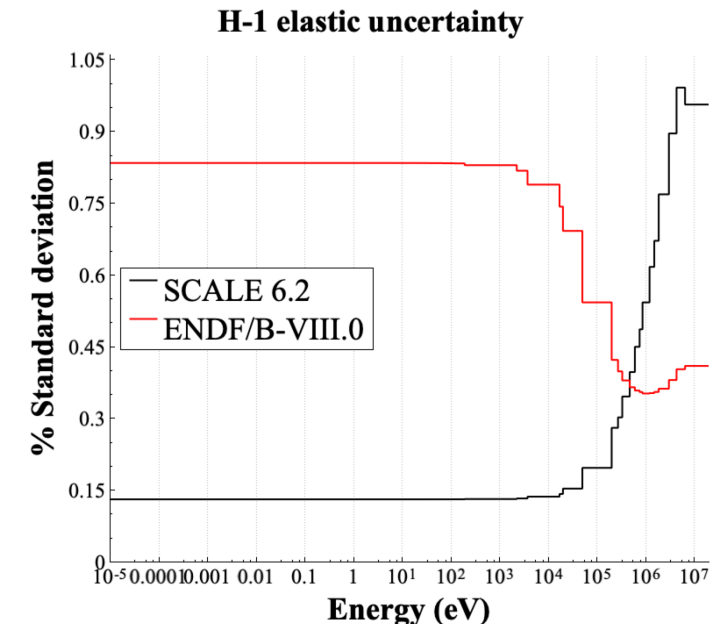
F. Bostelmann

Working group (industry, various DOE applications, nuclear data experts) is suggested to understand users' needs:

❑ Covariances needs

❑ General nuclear data problems of users

❑ Which integral experimental responses are best used for nuclear data validation to make our libraries more applicable for industry, DOE applications, etc.

❑ Which sensitivity tools are missing
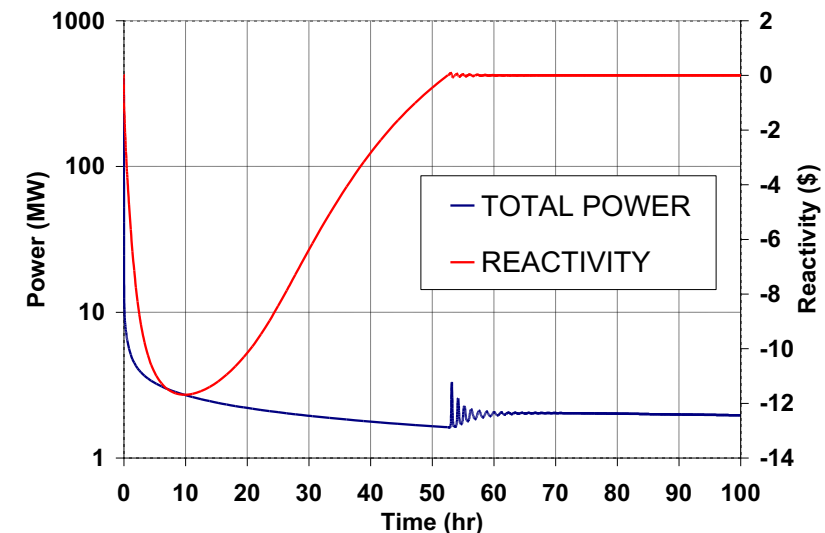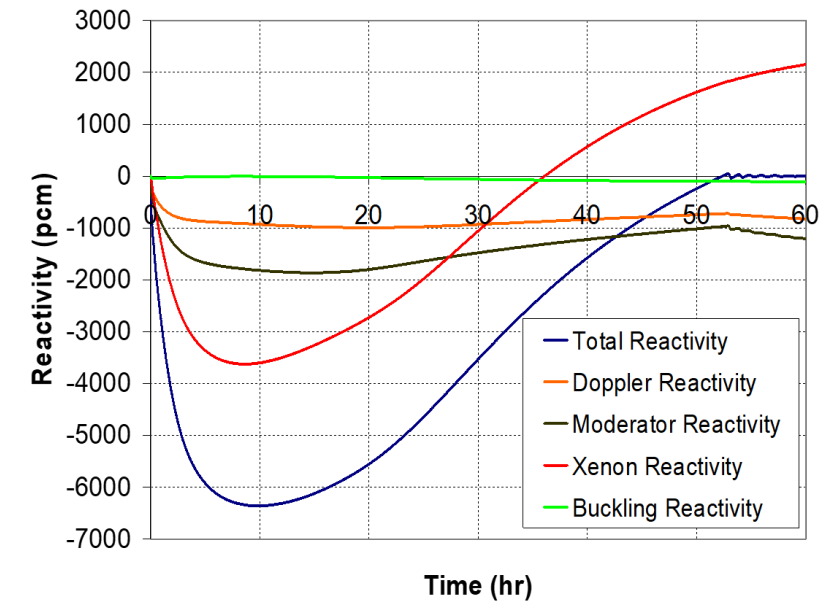
B. Rearden

Tools needed:

❑ Sensitivity tools to propagate uncertainties of nuclear data to various application

❑ Automated testing if covariances are realistic with differential/ integral data & verification

❑ Generating missing covariances

❑ General-purpose adjustment beyond criticality simulations

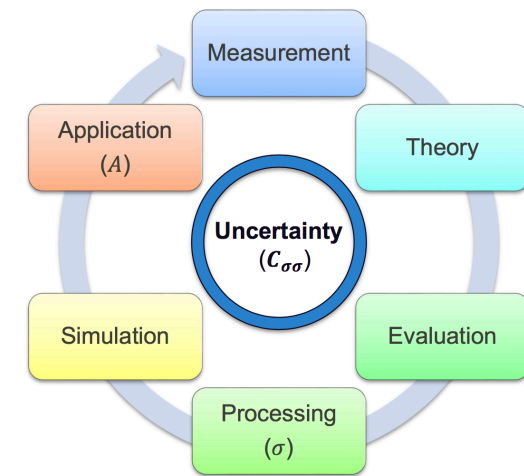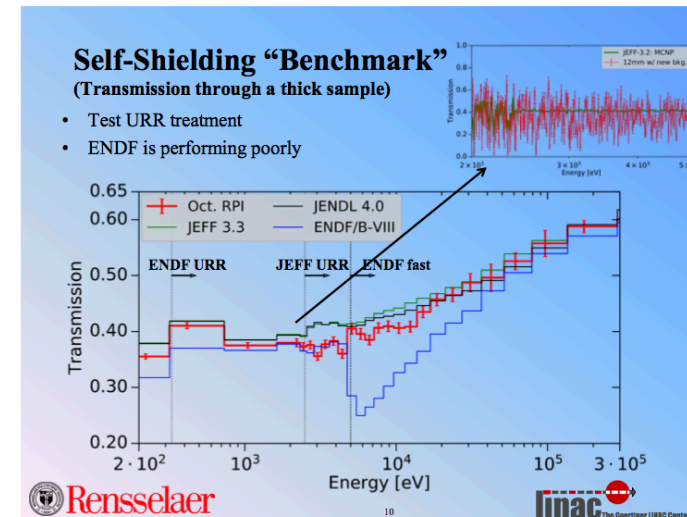❑ Tools (and formats) for processing FPY, TSL, angular distributions, multi-group?
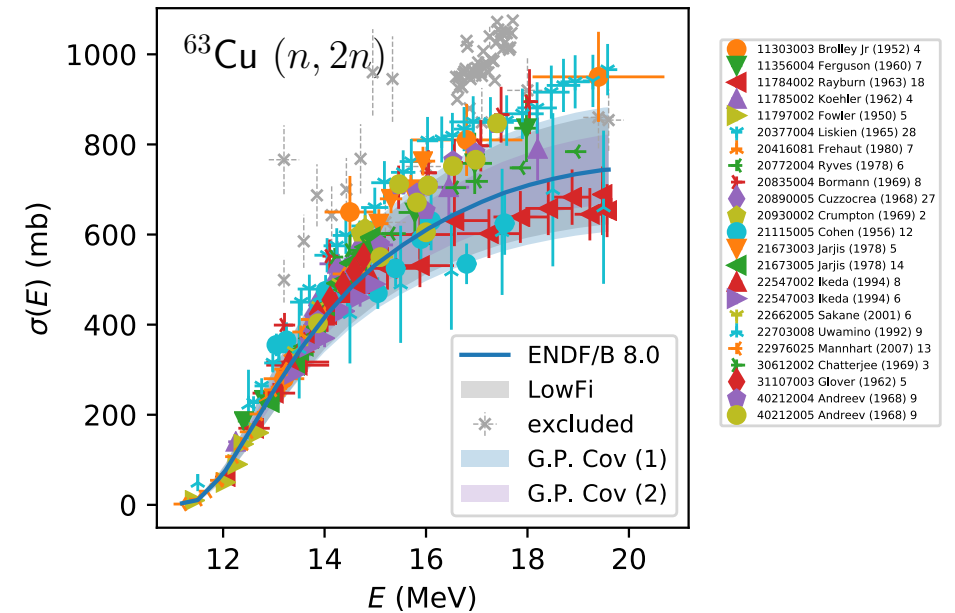
K. Wendt
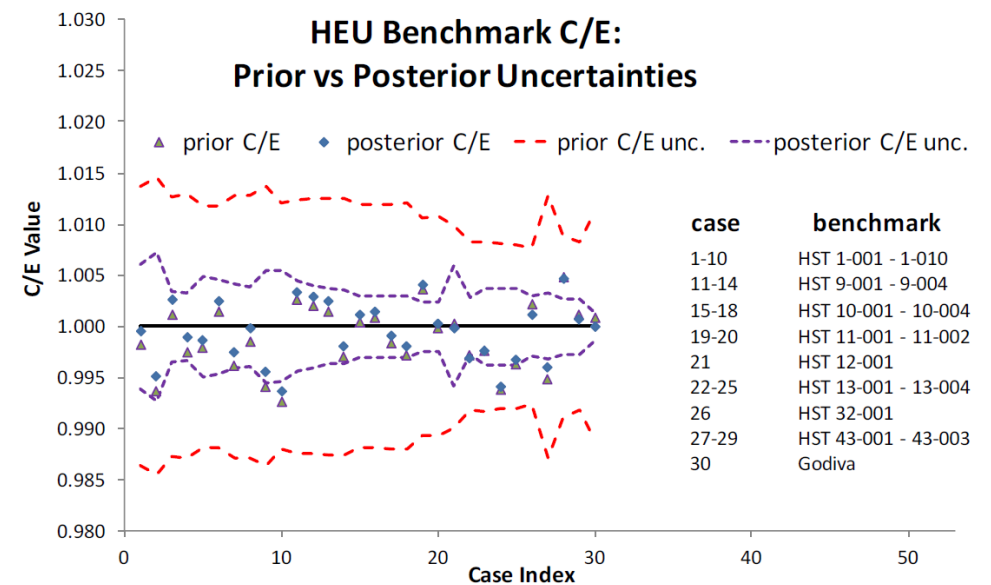
BJ Marshall

Validation experiments needed:

M. Rising

❑ Non-traditional validation experiments applicable for several applications areas (give uncertainties!)

❑ Vet existing integral experimental data suites to go beyond criticality, and engage with application community to obtain existing validation experiments

❑ Temperature-dependent validation measurements

V. Sobes